

A PROPOSED DESIGN FOR SAMPLING LOSS IN THE WESTSIDE SIERRA
AND COAST RANGE PINE AND FIR SUBREGIONS

By

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There has long been a need for obtaining factual information on timber loss caused by insects and other natural factors in the westside Sierra, Coast Range pine and Douglas fir subregions in California. The Forest Insect Laboratory at Berkeley has fairly adequate records of loss in eastside ponderosa pine compiled from numerous permanent sample plots throughout this subregion, but practically no permanent plots exist in any of the other subregions.

In 1939, a series of 38 twenty-acre permanent sample plots were established in the Burney area. Nineteen of these were in the pure ponderosa pine, typically eastside, and eighteen were in the mixed conifer type which is in the transition zone between eastside and westside. At the time of establishment, these plots were subdivided into eight units of 5 x 5 chains containing 2-1/2 acres each, and loss records have been segregated by these units over the period of about thirteen years. This system permitted a breakdown of annual loss records into units of 2-1/2, 5, 10 and 20-acres and furnished a basis for the study of the efficiency of plots of different sizes in sampling losses. Such a study has recently been completed and will be reported in more detail in a separate paper. This analysis showed, however, that the 2-1/2-acre plot was, theoretically, the most effective size of all those listed (Table 1). This analysis furnished a framework on which to build a design for the establishment of a sampling system in the westside Sierra and Coast Range pine subregions. Such a proposed design follows:

Objectives

The need for more factual information on annual loss and periodic drain caused by insects and other natural factors such as wind, snow, lightning or diseases in timber in the westside Sierra, Coast Range pine and Douglas fir subregions is increasingly apparent in the many requests received by the Laboratory. Such questions as: (1.) what is the annual drain from insects in each of these subregions, (2.) what is the annual fluctuation in loss, (3.) at what level is loss epidemic, are examples of some questions for which we have no ready or reliable answers. This lack of information is the one weak link in the formulation of management plans for these subregions.

Data on volume and growth by species in these subregions, although not completely adequate, are at least in the stage where the results can be expressed in terms of a plus or minus sampling error acceptable to most managers of

timber lands. No such precise estimates are possible so far as annual loss or periodic drains are concerned, and the objective of this paper is to suggest a design for a sampling system which will yield such information. The primary objective is to obtain drain information for all species for a ten-year period which will be subject to a sampling error of about 15 percent at the 95 percent level. The secondary objective is to obtain information on trends which will form a basis for interpreting needs for control recommendations on a year by year basis.

Number of Plots Needed

Theoretically, 115 2-1/2-acre plots would adequately sample a subregion for information on drain over a 10-year period, yielding information subject to a sampling error of about 15 percent at the 95 percent level for all species by each subregion (see Table II). The sampling error would be greater for information on loss in individual tree species than for all species combined. The 115 plots in each subregion are expected to yield a sampling error of approximately 22 for pine and 27 percent for other species compared to 15 percent for all species on a ten-year basis. If we assume we need 115 plots for a subregion and assuming that we are to sample the westside Sierra north and south and the Coast Range pine, then we would have a total of 345 plots in all. Considering all three subregions combined, with 345 plots, the expected sampling error for pine would be 12.6 percent, for other species 15.4 percent and for all species 8.7 percent. The plots would yield some factual information on annual loss trends for the combined subregions but would not be very reliable for any one subregion on an annual basis, as may be seen from Table II.

The Forest Insect Laboratory established 39 of these 2-1/2-acre permanent plots during the past field season on National Forest ownership, on the Mendocino, Trinity, Klamath, Shasta, Lassen, Plumas and Tahoe Forests. This experience indicates that a 2-man crew could establish an average of one 2-1/2-acre plot per day if they were easily accessible to roads or trails. This would include the time necessary to establish permanent boundaries, paint numbering or tagging each tree over 11 inches in diameter, the taking of diameters on all numbered trees, and enough heights to determine local site conditions. It is also estimated that one man could cruise an average of eight such plots per day for annual loss information, providing they were located near roads or trails. The experience on the 20-acre permanent sample plots in the Burney area has been that one man could cruise an average of six plots per day. It is expected that the actual cruising time for an average 2-1/2-acre plot would be about 15 minutes.

It is estimated that it would cost about \$40 to establish each plot, or about \$4,600 for each subregion. The estimated annual cruise cost would be about \$2.50 per plot or about \$300 for each subregion. These estimated cost figures include salary, subsistence, materials, travel and supervision.

Distribution and Stratification of Plots

A map is enclosed of the westside Sierra subregion north with the suggested location of permanent sample plots, Figure I. If we assume that 115 plots are

needed, this figures out to about one 2-1/2-acre plot for every township. This total number of plots can be reduced wherever there are existing permanent sample plots. For example, the Shasta Forest Company is proposing to establish a series of permanent tagged-tree plots in their Shasta tract. These might be substituted for the proposed plots Numbers 85, 86, 90, 91, 104, 105 and 106. The State Division of Forestry is planning to establish some permanent sample plots on the LaTour State Forest, and these could be substituted for Numbers 79 and 80. Many of our other cooperators already have established a number of tagged tree permanent plots as part of their over-all management policy. Most of these existing plots are smaller than the 2-1/2-acre unit suggested, but many of these could be incorporated into the proposed system on an equivalent acreage basis. If this were administratively possible, it would greatly reduce the number of new plots necessary. This possibility should be thoroughly investigated before any new plots are established. In addition, other cooperators have indicated an interest in cooperating in the establishment of new plots. By obtaining the cooperation of all parties interested in this problem, we should be able to achieve our objectives with a minimum of expenditure of federal funds. It would be highly desirable that these plots be stratified by timber type, age-density class and site, and the number in each strata distributed in proportion to the percentage of total area occupied by each strata (Tables III and IV). It is suggested that these plots be established on a restricted random basis, with the selection made from aerial photos. For convenience and economy in annual re-examination one restriction should be that they would be located within a quarter of a mile from an existing road, and that they be tied in to a section or quarter corner.

Aerial Possibilities

Since this proposed plot system will yield annual information on loss which is subject to considerable sampling error and, hence, will not furnish information on annual trends to the degree of precision desired, it is recommended that the possibility of the use of annual aerial photos be thoroughly investigated, where these photos might be taken of sample areas at the same time each year, preferably early in October. We have some evidence that aerial photos could be used for this purpose in the open stands of the eastside and probably could be used equally well on cut-over areas. Our limited experience in westside areas indicates that under present methods and techniques, such photos are of limited value. However, further study should be devoted to this whole problem.

Research Possibilities

These proposed tagged-tree plots in the westside Sierra and the Coast Range pine subregions have a multiple role in that they could be used for research purposes in a study of susceptibility in the mixed conifer type, and studies of growth. The above design is suggested for the westside Sierra subregion north, but the same design could probably be used for the westside Sierra subregion south, and the Coast Range pine and Douglas-fir subregion.

Re-establishment of Northfork Plot

The Laboratory has one large 80-acre permanent sample plot at Northfork on the Sierra National Forest. All of the trees on this plot are numbered and it is possible to obtain records of losses on this plot covering about a 20-year period. This plot was established in such a manner as to make possible the breaking down of this large plot into a series of 2-1/2-acre units, and it is suggested that the plot be re-established and analyzed to check the performance of the Burney plots and to obtain further information on sampling in the westside Sierra subregion south.

Information is lacking on the variance in loss in the Douglas-fir subregion, but it is planned to obtain this information as soon as possible, after which a sampling design will be proposed for this important subregion.

Cooperative Phases

Since these are suggested as cooperative plots, they should be designed to yield as much factual information as possible on all types of drain and should, so far as possible, meet the requirements of all agencies cooperating in their establishment and maintenance. If possible, these plots should be cruised for loss on an annual basis so that the cause of death can be determined as accurately as possible. In addition, these annual records can be used to supplement other loss data for trend information.

There are a number of details involved in plot establishment and maintenance of records. It appears that such details should be worked out by all cooperative agencies. A committee is suggested to work out these details. This committee would have representation from the Forest Insect Laboratory, the California Forest and Range Experiment Station, the Regional Office of the U. S. Forest Service, the California State Division of Forestry, the School of Forestry of the University of California, the Western Pine Association, and industry.

TABLE I

Comparison of Variance Mean, Coefficient of Variations and Sampling Error
of 2-1/2-Acre Sample Plots in the Burney Area

Average for a Ten-Year Period

Number of Plots Studied	144 plots
Mean Annual Loss - All Species 10-year Period	171.5 bd. ft.
Standard Deviation	±138.0 bd. ft.
Standard Error	± 11.5 bd. ft.
Variance	19,131 bd. ft.
Coefficients of Variation	80.4%
Sampling Error at 95% Level	13.4%
Number of Plots Needed to Sample a Subregion with an acceptable Sampling Error at 15%	115 plots
Number of Acres Needed	288 acres

TABLE II

Expected Sampling Error at the 95% Level by Species and Subregions
on an Annual and 10-Year Basis

Each Subregion - 115 - 2-1/2-Acre Plots

<u>Time Basis</u>	<u>Pine</u>	<u>Other Species</u>	<u>All Species</u>
10 year	21.8	26.6	15.0
Annually	72.5	88.5	49.8

Three Subregions - 345 - 2-1/2-Acre Plots

10 years	12.6	15.4	8.7
Annually	46.0	57.0	32.0

TABLE III

SUBREGION AREAS OF TIMBER CROPLAND BY TIMBER TYPES

Westside Sierra Subregion

<u>Timber Type</u>	<u>Thousand Acres</u>	<u>Percent</u>	<u>Number Plots</u>
Pine	2051	35.18	82
Redwood	-		
Douglas-fir	39	0.67	
Fir	605	10.38	24
Mixed Conifer	3135	53.77	124
Total	5830	100.00	230

Coast Range Pine

<u>Timber Type</u>	<u>Thousand Acres</u>	<u>Percent</u>	<u>Number Plots</u>
Pine	326	10.81	13
Redwood	2	.07	--
Douglas-fir	564	18.71	21
Fir	145	4.81	6
Mixed Conifer	1978	65.60	75
Total	2015	100.00	115

TABLE IVDISTRIBUTION AND STRATIFICATION OF SAMPLE PLOTS
BY SUBREGIONSWestside NorthAge Class and Density

<u>Timber Type</u>	<u>OGD</u>	<u>OGO</u>	<u>OGVO</u>	<u>YGOG-D</u>	<u>YGOGO</u>	<u>YGOGVO</u>	<u>Total</u>
Pine	4	15	5	3	8	6	41
Fir	4	4	2	1	1		12
Mixed Conifer	14	23	6	4	11	4	62
Total	22	42	13	8	20	10	115

Westside South

Pine	4	15	5	3	8	6	41
Fir	4	4	2	1	1		12
Mixed Conifer	14	23	6	4	11	4	62
Total	22	42	13	8	20	10	115

Coast Range Pine

Pine	2	4	2	0	3	2	13
Fir	3	3					6
Douglas-fir	8	8	5				21
Mixed Conifer	16	27	7	5	14	6	75
Total	29	42	14	5	17	8	115

All Subregions

Pine	10	34	12	6	19	14	95
Fir	11	11	4	2	2	0	30
Douglas-fir	8	8	5	0	0	0	21
Mixed Conifer	44	73	19	13	36	14	199
Total	73	126	40	21	57	28	345

